Continuous Grain Cropping

John Letts explains how he grows heritage wheat on the same field year on year, and why it offers a viable alternative to mainstream chemical and organic arable systems.

There are two orthodox ways of growing wheat in Britain today: the so-called "conventional" method, which employs chemical fertilisers, herbicides and pesticides; and the organic method reliant for fertility on leys (or artificial meadows) of clover and grass. Both have their problems. The millions of tons of agrichemicals that conventional farmers apply to cereal crops every year destroy biodiversity, degrade the soil and release massive amounts of greenhouse gases into the atmosphere. Intensive organic grain production requires huge areas of land to accommodate the leys, and extravagant use of diesel for all its cultivations.

The author: photo by Mark Lord

Here I propose a third approach, Continuous Grain Cropping (CGC), which avoids all of these problems. It draws on the philosophy and farming practices of rice farmer Masanobu Fukuoka as described in his book *One Straw Revolution*, and of Marc Bonfils who adapted some of Fukuoka's principles to wheat cultivation.[1] It relies on the use of a genetically diverse and constantly evolving population of traditional varieties of wheat, that I call "heritage populations" and has much in common with Medieval farming techniques. The best way to explain this approach may be to outline the history of wheat cultivation.

Neolithic Wheat

The first humans to make flat breads from the ground-up seeds of wild grasses were hunter-gatherers who lived in the Middle East over 20,000 years ago. The seeds of wild einkorn, emmer, barley and rye were fairly easy to collect and could be stored for later use.[2] No one knows whether these wild grains were first used to make porridge for infants, soup-like beer or rustic sourdough crepes. Many archaeologists believe that porridge made from crushed grains provided a caloric supplement primarily for infants, which reduced child mortality and so fuelled population growth.

The biggest problem for any hunter-gatherer with a penchant for porridge was that the ears of wild grasses shatter and fall to the ground when they ripen, so wild stands had to be harvested before they shattered in the hot sun.

Nature's drive to create genetic diversity ensures that one in 10,000 wild grass plants contained a mutation that prevented its ears from shattering when ripe.[3] In natural grass stands this mutation would be deleterious as it would prevent the plant from dispersing its seeds, which would fall to the ground and grow into a congested and unproductive clump. But if a stand of wild grass was collected late in the season after most of the ears had shattered, the harvest would contain a larger proportion of seeds of non-shattering plants. If seed from this patch was broadcast onto new land, the next harvest would contain more non-shattering plants. Gradually, this cycle of unconscious selection increased the proportion of non-shattering ears in the population, eventually leading to a fully domesticated crop, which cannot survive in nature without being collected and resown by humans.

Only a very small subset of the wild grasses that grew on the steppes of Central Asia were domesticated at the start of the Neolithic period, but these first crop populations or land-races were genetically diverse and therefore hardy, resilient and adaptable. Wild grasses were genetically programmed to use whatever nitrogen they could scavenge to grow tall stems in order to out-compete neighbouring plants, so the first cultivated cereals self-selected to acquire tall stems which helped them outgrow the weeds that spread with cereal crops to Europe.[4]

Medieval Wheat

The problem with the tall stem strategy is that if carried too far, the plant falls over, or "lodges". This is most likely to happen if a very fertile soil causes the seed head to be heavier than the stem can bear.

Medieval farmers in England knew that cereal crops would fall over if they were grown in rich soil. The agronomic challenge they faced was keeping fertility – ie nitrogen levels – low enough to prevent lodging, but sufficient to generate survival rations in a poor year and a surplus in a good year. Contrary to both popular and academic belief, any significant increase in fertility in a Medieval field in 1500 AD would have led to crop failure and starvation.

In practice, excess fertility was never a problem, significant surplus was rare, and sufficiency and famine were regular bedfellows. Wheat yields were only about 1.5 tonnes per hectare and limited by the need to rotate crops between three fields: wheat or rye (bread corn) in year one, barley or oats (drink corn) in year two and a fallow in year three.[5]

One of the reasons Medieval grain yields were so low was the lack of soil organic matter: straw was removed from the fields for thatching, fuel and other purposes at every harvest. Almost all of the nitrogen taken up by the crop during the growing season was removed in the grain and straw.

Nor were the open fields normally manured. Medieval farmers lacked winter fodder and slaughtered many of their animals in the autumn, and so did not produce much manure. Nitrogen was replenished primarily by natural deposition and the decomposition of roots during the fallow year.

Medieval farmers grew genetically-diverse mixtures of varieties we now call "landraces"' containing variety lines dating back at least to the Saxon period. Over the centuries, plants that were better adapted to local growing conditions contributed more seed to the harvest, and those that were less well adapted contributed less. As long as seed was replanted from the previous year's crop, natural selection ensured that the populations being grown remained well-adapted to local growing conditions, and were as resilient and adaptable as possible within the limits of the genetic diversity present.

Not only the seedcorn, but also the plant-life in a Medieval wheat field was more diverse than it is today, harbouring now rare arable weeds that were harvested and re-sown with the crop, or whose seeds lay dormant in the soil until their germination was triggered by tillage. This flora was grazed by a rich population of micro-fauna and insects, which in turn fed a large population of field mice, hedgehogs, birds, etc.[6]

Was a medieval wheat crop ever as perfect as in this painting by Breughel the Elder? Probably not, but it does show how tall wheat grew in the Middle Ages.

The Agricultural Revolution

Around the early 17th century farmers began to shift from the exhaustive, Medieval three-field rotation to the restorative, animal-focussed, four course rotation of clover/wheat/turnips /barley. The use of clover or other legumes to capture nitrogen from the atmosphere developed in Flanders in the late 16th century, and clover seed began to be exported from the Low Countries to England in the 1650s.

Initially, the switch to a Flemish style four-course rotation would have reduced the cumulative wheat yield per hectare because they were now growing wheat once in a four year rotation instead once every three years. The grain yield from a single crop could not be raised simply by applying more manure or growing clover because of the increased risk of

lodging, which was greater in England than in Flanders due to the longer, wetter and cooler growing season.

Wheat yields began to increase significantly in the mid 18th century when farmers and plantsmen began to alter traditional landraces so they would yield more grain on soils enriched with clover and manure. Breeders first eliminated the tallest lines with the weakest straw and the smallest ears, and then created new mixtures that produced flour that was better suited to industrial baking (i.e. for making yeast-risen bread rather than sourdough). Medieval crops had averaged about 1.6 metres in height, but this decreased to about 1.2 metres in the early 19th century – still double the height of modern varieties.[7] Even the most robust 19th century selections lodged when grown in high nitrogen soils.

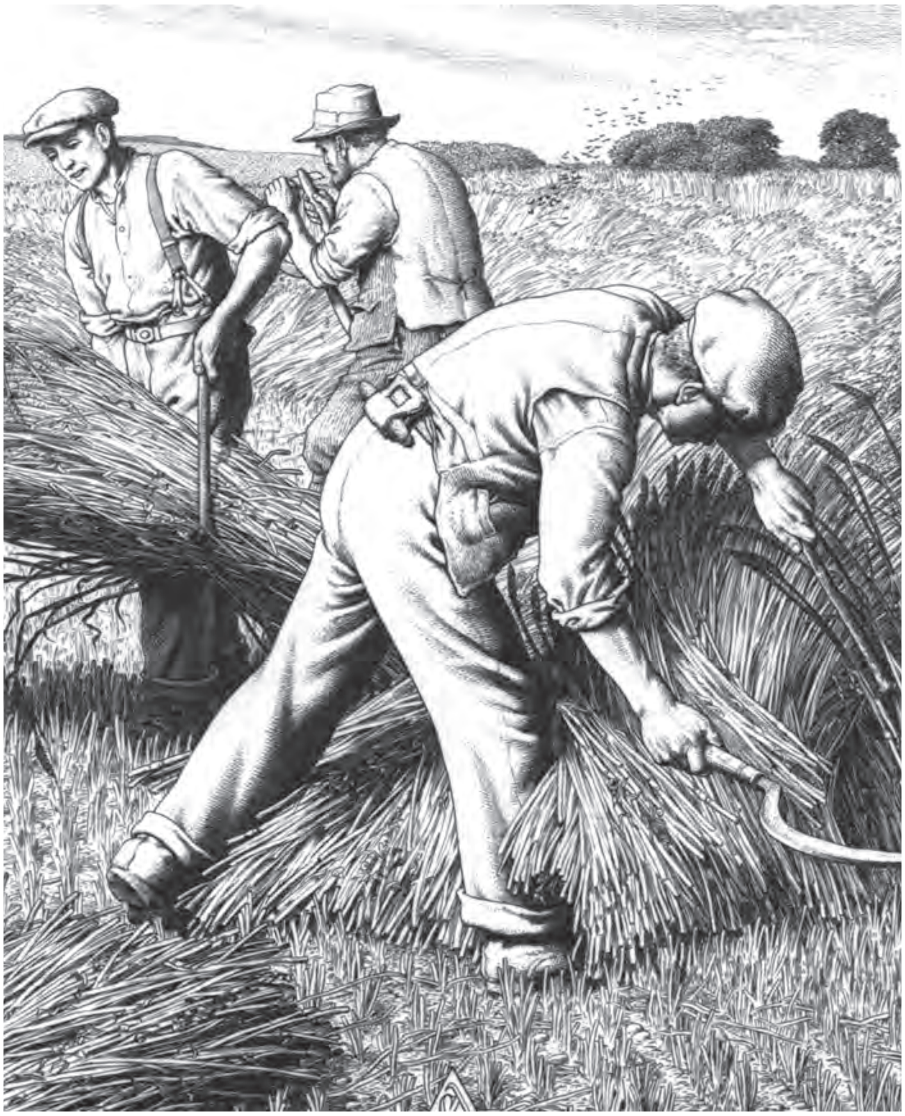
By the mid-19th century farming in Britain had been transformed physically by the enclosure of arable and common land, and practically by the application of a more scientific approach to crop production. This transition allowed farmers who had benefited from enclosure to specialise in growing meat and dairy products for those who could afford to buy them rather than less profitable grain for the bread of the masses.

Fertility and the Green Revolution

Industrial agriculture began in 1843 when John Bennett Lawes patented the first super-phosphate fertiliser, and in 1843 opened the first artificial fertiliser plant. The Rothamstead research centre near London, originally Lawe's private estate, set up its first well-publicised experiments at this time to prove that chemical fertilisers eliminated the need for crop rotation.[8] Throughout the 19th century, the rapidly growing demand for nitrogen fertiliser had been supplied primarily by guano mined in Chile, and later by sulphate of ammonia. By the later 19th century agricultural scientists were claiming that there was no need to rely on natural processes or leguminous crop rotations to keep soils fertile because yields could be maintained indefinitely with artificial fertilisers. In 1913 the discovery of the Haber-Bosch process, enabling synthetic ammonia to be made from natural gas, coal or oil, launched the modern fertiliser (and explosives) industry.

With abundant supplies of nitrogen fertiliser manufactured from cheap fossil fuels, the main constraint on wheat yields was the tendency to lodge when the seedhead became too heavy. In the UK, higher yielding hybrid varieties of wheat created primarily at the Plant Breeding Institute in Cambridge supplanted traditional heritage lines and mixtures in the first decades of the 20th century. Yields and gluten content increased, but these varieties still had relatively tall stems and would lodge if farmers applied too much nitrogen fertiliser.

Then in the 1920s, genes were identified in experimental Japanese varieties that controlled straw height. Varieties containing dwarfing genes (such as Norin 10 which was seized by American forces after WWII) were crossed into tall stemmed American and European strains forcing plants to redirect surplus energy into producing more grain rather than straw. Much more fertiliser could now be applied to crops in order to maximise yield and gluten content without lodging. Dwarfing genes were incorporated into commercial cereals throughout the world in the 1950-60s, and the first such variety was released in the UK in the mid-1970s. All modern wheat varieties now contain dwarfing genes and have been developed for conventional production systems.



Windswept Corn, by Stanley Anderson, 1938. When wheat lodged it was a long business harvesting it with a sickle — and the quality of the grain would be poor.

The introduction of HYVs (High Yielding Varieties) containing dwarfing genes to Mexico in the late 1940s initiated a period of agricultural transformation now known as the Green Revolution. Plant breeders promised that their new varieties would banish hunger forever, but ignored the fact that higher yields could only be obtained with massive inputs of artificial fertiliser and agrichemicals, and industrialised production systems reliant on fossil fuels.

The new miracle varieties were of little use to poor farmers, and destroyed natural ecosystems, but generated huge profits for the wealthy farmers who could afford them and the corporations who sold the seed and the chemical inputs they required.[9] Although ostensibly created to "feed the world", HYVs are primarily used in industrialised countries to transform fossil fuels into cheap grain to produce animal products to feed affluent consumers.

In the UK, in 2017, farmers grew nearly 14 million tons of wheat on 1.79 million hectares, at an average yield of 7.8 tonnes, among the highest in the world. However the quality is variable, largely because the genetic uniformity of the varieties used cannot adapt to the vagaries of the British maritime climate. Frequently, wheat grown for bread does not achieve a milling grade and is sold as feed wheat. Every year the UK imports about 1.7 million tons of high-gluten milling wheat for bread, primarily from North America, Germany and France, and exports between 0.5 and 2.8 million tons of feed wheat primarily to the EU and North Africa.[10]

Organic Farming

With the arrival of artificial fertilisers in the mid 19th century, many farmers abandoned crop rotation entirely, but yields eventually began to stagnate due to acidification, fertiliser "burn", soil compaction and a massive decline in soil organic matter .[11] Wheat yields dropped 40 percent in Germany in the 1920s and overuse of soils in the USA reduced yields and resulted in the dust bowl in the central plains in the 1930s.[12] As a result most conventional farmers today rotate their crops at least once every four years.

Organic farming, as we know it today, began as a response to these problems, initially in Germany and then in Britain in the late 1930s, when Lady Eve Balfour began experimenting with methods that led to the creation of the Soil Association in 1946. Organic growers refuse to use artificial fertiliser and instead emulate the farmers of the 18th century in growing *restorative* crops that increase fertility, typically a clover and grass ley, in rotation with *exhaustive* crops that absorb this fertility and convert it into food.

However, most organic grain producers grow the same high yielding cereal varieties as farmers who use chemical fertilisers: dwarf-stemmed, genetically uniform, hybrid varieties created through rigorous selective breeding. Organic and conventional farmers therefore agree on two widely accepted agronomic principles: 1) wheat must be grown in high nitrogen soils, and 2) wheat cannot be grown in the same field for more than one to two years without draining the soil of nutrients, and dramatically increasing losses to pests and diseases.[13]

Because high yielding wheats are so demanding of nutrients, most organic grain farmers follow a longer rotation than the Flemish four course, with greater emphasis on legumes. A typical five year rotation would grow a temporary clover-grass ley for three years which is fed to livestock and ploughed in, followed by a single crop of high quality milling wheat for human consumption, and then another of cereals or roots to feed to animals, before the field is put back to clover and grass. Most of the nitrogen released by the decaying clover ley is absorbed by the first crop of milling wheat. The majority of organic holdings growing cereals are therefore mixed farms feeding the majority of their crops to animals. Some do not produce any grain at all for human consumption.

Moreover, the organic grain sector in the UK is miniscule, growing only 40,000 hectares of cereals each year, three quarters of which is fed to animals.[14] The current UK harvest of about 50,000 tons of organic wheat would provide every person in the UK with one and a half loaves of bread per year – a sobering reminder that only 2.9 per cent of the UK's farmland is managed organically, and 82 per cent of this is permanent pasture or clover-grass ley. In terms of land use, organic farming in the UK is focussed on rearing animals rather than growing grain.

Land-Hungry

Many consumers would rejoice if all of the UK's farmers were forced to adopt organic methods overnight – but is this feasible? The main challenge is that organic yields are lower than conventional yields even when soils are heavily manured and high in organic matter because plants do not assimilate as much nitrogen from their roots as they do when crops are drenched at regular intervals with soluble artificial fertilisers. Modern wheat varieties planted after a three year ley on good organic land can yield about five tons per hectare per year, which is less than two thirds of the average conventional yield.[15]

Val Littlewood

On average, each of the UK's 66 million citizens consumes about 60 kg of (mostly white) wheat flour a year comprising about 15 percent of the calories needed to maintain a healthy diet. This is about 4.55 million tons of wheat for the entire country, which in theory could be grown on 910,00 ha of good quality organic land, less than one sixth of the area currently used for arable and ley.

However the wheat crop for human consumption would be only one year out of five in the rotation, so more than 4.5 million hectares of arable land would be required to grow all the necessary wheat, an average annual yield (averaged over the 5 year rotation) of about one tonne of wheat per hectare. A fifth of this area would be down to wheat at any one time: three fifths would be producing fodder, ideally for dairy cows, from the three years of clover ley; and the other arable crop might be barley, oats, roots or beans, either for human food or livestock feed.

To work out how much arable land an organic mixed farming regime would need to feed the entire nation requires a complex calculation beyond the scope of this article. But even highly productive leys dedicated to state-of-the-art organic milk production supply far fewer calories per hectare than a decent crop of organic wheat. There can be no doubt that a great deal more land would have to ploughed up in order to feed the entire country through organic mixed farming. My own calculation, made elsewhere, is that even if the UK were to stop feeding wheat to animals, and halved the use of other cereals for animal feeds it would still need some eight million hectares of temporary clover-grass ley – a third of the entire country – to fertilise the land needed to grow enough food for everyone.[16]

We must also consider the effect modern organic grain production has on CO_2 emissions and on biodiversity. It is good that organic agriculture eliminates the use of artificial fertilisers, which among other impacts are responsible for high carbon emissions, but it can only do so through intensive cultivation, using tractors to eliminate weeds and to sow and plough up temporary leys – requiring significant diesel consumption. While not as devastating as the application of herbicides and pesticides, these cultivations eliminate biodiversity.

Continuous Grain Cropping

In the seventy-five years since the founding of the Soil Association, organic mixed farming has failed to provide a viable alternative to industrial wheat production in the UK, largely because it has not rid itself of modern agriculture's obsession with nitrogen. In contrast to rotational organic farming, nature prefers a low input approach. Nitrate, the main form in which nitrogen is absorbed by plants, is highly soluble so that natural soils contain very little plant-available nitrogen and are never as fertile as a modern organic field or garden.

Over the past decade, I have experimented with a more natural, low input approach on a small farm in Prestwood, Buckinghamshire. Relatively poor, stony and alkaline fields have yielded three tonnes per hectare of high quality heritage grain every year for six years – almost three times the output of a rotational organic system – using a stockless, Continuous Grain Cropping (CGC) wheat-growing system. This has been achieved without incurring any problems with disease and while building organic matter in the soil and biodiversity both above and below ground.

A CGC wheat field mimics the ecological structure of a natural grassland. The success of this approach depends on six principles:

(i) early autumn planting of winter cereals that require vernalisation (ie a cold period).

(ii) high genetic diversity within the crop (i.e. populations or genuine landraces)

(iii) undersowing cereal crops with short white clover

(iv) no ploughing or inter-row tillage

(v) leaving all crop residues on the soil surface after the harvest, and

(vi) no use of artificial fertiliser or agri-chemicals.

A CGC system deals with all of the challenges faced by an arable farmer: maintaining fertility, outcompeting weeds, preventing disease and reducing carbon emissions.

(i) Nitrogen The primary difference between a CGC wheat field and a natural grassland is that the grain is removed every year, and the crop is undersown with white clover in order to replace some of the nitrogen that is removed. Unlike Medieval farmers who used straw for thatch or for burning, or modern farmers who use or sell it for bedding, all of the straw and stubble is chopped up and left on the soil surface as mulch. Straw contains only 5 kg of nitrogen per tonne, but long-stemmed heritage varieties yield over 5 tonnes of straw a hectare, so return a significant amount of nitrogen to the soil.

The nitrogen from the breakdown of clover, straw and weeds, along with natural deposition from the atmosphere, is sufficient for nitrogen levels to be in surplus and give me yields that are double those of Medieval farms.[17] Theoretically, this will eventually push yields to their genetic maximum and perhaps cause lodging – although this point has not yet been

Comparative Nitrogen Budgets

for a single year of wheat cultivation in a high input organic system, a low input continuous grain system, and a two year Medieval rotation; all figures in kilos per hectare.

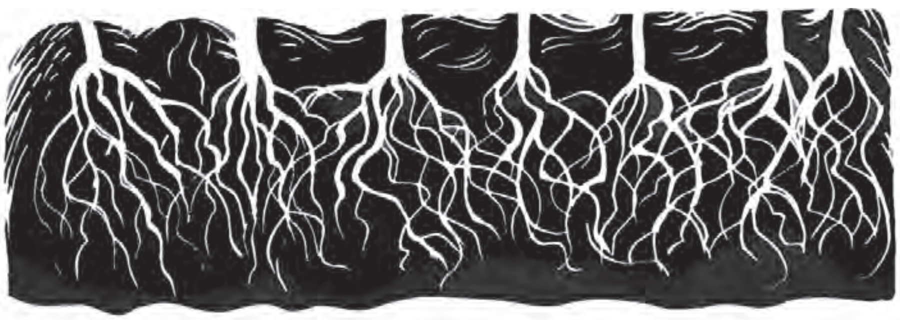
Nitrogen from	High Input Organic	CGC	Medieval
Atmospheric Fallout	25.0	25.0	18.8
Seed	5.0	5.0	5.0
Straw Residue	2.9	28.5	2.9
Weed Residue (surface)	1.1	5.7	1.1
Mineralisation (crop roots)	21	26.3	26.3
Mineralisation (exudates)	20.0	40.0	40.0
Mychorrizae	5.6	11.1	5.6
Mineralisation (clover)	350	216.6	0.0
Yield of grain	5000	3000	1500
N removed in grain	100	60	30

From, Letts, J, *Continuous Grain Cropping CGC: How to Grow Grain While Increasing Biodiversity and Sequestrating Carbon*, 15 March 2020, awaiting publication.

reached after six years of continuous cropping in experimental fields in Prestwood. I get higher yields because my populations are dominated by post-Medieval varieties (selections from landraces), many of them 19th century cultivars, as well as older Medieval lines (eg. Red Lammas). Some very early 20th century lines have also crept into the blend. These Medieval selections have tougher stems and larger ears. The crop will fall over if I add artificial fertiliser or a lot of manure, but I keep my soil just at the edge of too much/not enough.

(ii) Weeds Short weeds contribute useful organic matter in a CGC system, but once a crop is established with an understorey of white clover, tall heritage cereals will outcompete all other vegetation in the field. Broadcasting and direct drilling without ploughing and with minimal soil disturbance also discourages the germination of aggressive arable weeds such as charlock and mayweed.

(iii) Disease Many crop diseases occur in a CGC field at low levels, but by maintaining a high degree of genetic diversity within the crop, biodiversity within the field, and low levels of soluble nitrogen, heritage grain crops remain healthy and resistant to attack. A mulch on the surface of the soil prevents fungal spores from splashing back onto the crop from the soil surface, and an active community of micro-organisms digests the inescapable rain of spores that falls onto every field. A healthy agro-ecosystem also ensures that any proliferation of disease-carrying pests (eg. aphids) is rapidly matched by an increase in predators. Although new diseases may blow in, a healthy, genetically-diverse crop can offer a community level response to attack, whereas a modern variety relies only on genetic resistance bred into the crop – and agrichemicals.



(iv) Carbon Emissions CGC has an important role to play in reducing agricultural carbon emissions. Like grassland, low input cereal crops (and also their clover understorey) capture carbon and pump it into the soil as roots and root exudates. Heritage cereals have more extensive root systems than modern varieties, and produce more than twice as much high carbon straw, which ultimately ends up in the soil. A CGC crop also requires less diesel for tractor cultivation than an organic rotation.

Heritage Populations

The resilience of a CGC crop depends on growing populations of heritage varieties with high genetic diversity, created through what is known as "evolutionary plant breeding" (EPB).[16] Whereas conventional plant breeding concentrates on manipulating and improving individual lines of plants, EPB focusses on the entire crop community. To a large extent this replicates what our ancestors did unconsciously for thousands of years, but also draws on scientific methods that can help maximise diversity and a crop's ability to evolve and adapt to changing circumstances such as short or long term changes in the climate.

To create a genuine heritage grain population, as wide a range as possible of true heritage lines must be obtained from gene banks or other sources in the UK and abroad. These are first grown in separate plots to screen out non-viable varieties (eg short-stemmed or early ripening wheat from Spain). Eventually, all of the most suitable lines are mixed and grown together in the same field. A heritage wheat crop grown in the UK conditions will multiply at least ten-fold by weight every year. In the first few years a new population will lose many lines and change significantly depending on growing conditions and selection pressures.

In its early years, a population will ripen unevenly, which can be problematic at harvest time. Early ripening varieties will shatter or sprout in the ear, which will naturally prevent them from contributing much seed to the harvest. A population can be skewed to ripen earlier or later by simply harvesting it earlier or later (weather permitting). Either way, outliers on the bell curve of ripening time will be reduced year on year.

Heritage cereals have larger root systems commensurate with their tall stems, and are able to extract nitrogen, moisture and other nutrients from deep with the soil, and are particularly good at surviving drought. This allows them to thrive, and produce top quality grain, in the driest British summer.

Unfortunately, government-funded research bodies have been unwilling to support research on breeding cereals for low input production systems using an evolutionary approach. In a private initiative, however, a "composite cross population" of dwarf hybrid wheats originally developed for conventional production


Adrian Arbib

A relatively small winnowing machine built in 1890, brought back into life by the author.

systems at the John Innes Centre in 2001 was repurposed for the organic sector by the late Martin Wolfe at Wakelyns Agroforestry. Eleven "high grain Quality" (Q) lines were crossed with eight "high Yielding" (Y) varieties to create a YQ population that could be grown with less fungicide and pesticide. Although successful in practice, it was not successful commercially. With the support of the Organic Research Centre, YQ was then grown for ten years in intensive organic conditions, which encouraged the domination of genetic lines that were better adapted to organic conditions.

YQ is not a heritage grain population or a landrace. It is a mixture of hybrid lines which, though more diverse than any commercial modern variety, has a shallow gene pool compared to a genuine landrace or heritage population. Wheat rarely cross-pollinates, so the genetic diversity now present within the YQ population is the product of intensive natural selection operating on a relatively uniform population of recombinant lines that was created by crossing a small number of genetically similar, hybrid parents. YQ wheat can perform well in intensive rotational organic systems with good weed control but it is not suitable for growing in low input conditions. Wakelyns YQ is now being grown on several hundred acres to supply a growing number of artisan bakers. Its acceptance by bakers is proof of concept, and it will hopefully be followed by more genetically-diverse populations, better adapted to low input and organic conditions.

Tomorrow's Core Product

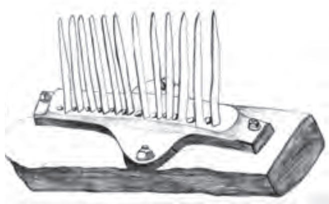
Conventional farming is destroying biodiversity and warming the planet. We must adopt more sustainable ways of growing grain if we are to avert even greater disaster. Intensive organic farming is focussed on growing animals for meat and dairy, and cannot produce the grain we need as long as this depends on crop rotation and fertility building clover-grass leys. However, organic farmers could feed the UK if they adopted a low input CGC approach, which would preserve crop genetic diversity, increase biodiversity and sequester massive amounts of carbon.

Many organic farmers will struggle to adopt a continuous cropping regime as this requires a fundamental change in farming philosophy – but this is exactly what is required if we are to radically alter the way we feed our families and communities. Most organic farmers will continue to grow modern varieties that fit into their existing rotations. Some will choose to grow heritage lines or mixtures because the market for heritage flour is expanding rapidly – but their output will be limited by their dependence on crop rotation. Many will also struggle to keep fertility levels low enough to prevent heritage grain crops from falling over. But today's niche crop is tomorrow's core product, and the demand for sustainable alternatives will grow in the face of global warming.

Heritage grains, however, offer many advantages, particularly for smaller growers:

- they are hardier than modern varieties, and can be grown on soils now considered unsuitable for growing grain, or not included in arable rotations.
- Since there is no need for a clover-grass ley to be mown and ploughed in, much less land is needed to produce a wheat crop of a given size, and no equipment is needed for operations such as mowing and ploughing in the ley.
- Fields previously considered too small for growing modern varieties within a rotational system could grow heritage cereals every year, without animal or green manures. Small producers could make a significant contribution to the local grain economy whether they operated mixed farms or stockless systems.

In an ideal world, local farmers would grow sustainably-produced grain for sale to local millers, who would then supply flour to local bakers and consumers. One of the challenges in rebuilding local grain economies is the lack of seed. The other is lack of equipment suited to small scale cereal production – from harvesting equipment to grain cleaners, driers and small mills for bakery and farm-based milling. London and Manchester will never again be fed with grain that is harvested with scythes and sickles, threshed by hand, and milled on stones in water mills in the countryside – but many smallholders are now growing their own cereals, and small family farms are beginning to fill the expanding market for locally grown, artisanal, chemical-free grain.



Low input wheat can be grown on a small-scale. This crop was grown by Paul Lovatt Smith from a mixture of heritage seeds. A winter crop of grass was rotovated to a depth of two inches, and the seed sown in shallow furrows dug with a mattock. The ears were harvested by hand -plucking, and threshed in a small farm-scale machine imported from India. An alternative is to reap with sickle or scythe and thresh with a reed-comber— the one pictured above was made in Northern Ireland.

For more information see https://www.sftg.co.uk/growing-your-own-bread/

Civilisation exists today because our ancestors used low input methods to grow grain for most of the past 10,000 years. Over the past two centuries humanity has gorged on cheap fossil fuels, and developed agricultural sectors that fed an exponential rise in population and wealth – but we have painted ourselves into a socially and ecologically unsustainable corner. The solution is not further intensification, but rather to decouple the unnecessary linkage between nitrogen use and grain output. We can grow enough grain to feed Britain profitably while increasing biodiversity, rebuilding our soils and making grain production in the UK carbon negative. And we can transform the way we grow food if we embrace a genuinely low input, agro-ecological approach that values resilience and sustainability as well as output.

This article is drawn from a longer unpublished paper, see ref. 16
Original artwork by Val Littlewood: valerielittlewood.uk

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